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ABSTRACT

The problems inherent in the use of norm-referenced achievement tests in evaluating reading comprehension may be alleviated through the use of a criterion-referenced, cloze type test. The Degrees of Reading Power (DRP) Test, published by the College Entrance Examination Board (1980), was designed to measure students' ability to understand English prose written at different levels of difficulty. A modified cloze procedure is used in which each passage includes seven sentences with one word deleted. This study investigated the applicability and research potential of the DRP Test for a sample of 100 hearing impaired college students at Gallaudet College. The distribution of scores on the DRP scale of prose difficulty were used to evaluate the degree of compatibility between text difficulty and student reading level. Comparisons were made with DRP test score distributions for hearing students at different grade levels. DRP scores were correlated with several factors including degreeof hearing loss, age at onset of deafness, articulation ability, and years of experience in sign communication. Further research is needed to establish the relationship between prose difficulty and level of comprehension on the DRP scale for deaf subjects; nevertheless, the DRP Test is held to be a valuable instrument for the assessment of reading achievement in hearing impaired students. (DWH)

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PERFORMANCE OF DEAF COLLEGE STUDENTS ON A CRITERION-REFERENCED "CLOZE" TEST OF READING COMPREHENSION*

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INTRODUCTION

The reading comprehension of deaf students has been investigated in numerous studies, typically using norm-referenced achievement tests to provide grade-equivalent scores (Balow, Fulton & Peploe, 1976; Reynolds, 1980; Trybus & Karchmer, 1977; Wrightstone, Aranow & Moskowitz, 1963). The results of such studies are generally well known, and show that deaf students' reading achievement scores, on the average, are substantially below the mean reading levels achieved by hearing students of the same age. For example, in data reported by the Office of Demographic Studies at Gallaudet College, the average reading achievement for 17 year old deaf students nation-wide is between a third and fourth grade level by comparison with norms for hearing students (Trybus & Karchmer, 1977).

Norm-Referenced Tests

Grade-equivalent scores such as these are easy to understand, but suffer from several inherent problems, including: (a) the lack of equivalency between norms for different tests; (b) the common misinterpretation of grade-level scores as a goal or ideal performance; (c) the tendency to equate grade-level reading test scores with the grade-level rating assigned to texts, when in fact the two measures are not necessarily equivalent; and (d) the labelling or biasing effect of such scores (Angoff, 1971; College Board, 1980). Furthermore, when norm-referenced tests are used with deaf subjects, interpretation is complicated by

Tm 840 239

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the fact that the norming sample usually consists only of hearing students.

An additional problem inherent in the structure of many tests of reading comprehension is that questions and response options presented after a reading passage may be written at a level of semantic and syntactic complexity equal to or even greater than the passage itself. Consequently, errors may be partly attributable to a failure to understand the questions or response options rather than the reading passage on which the difficulty of the test is based.

Criterion-Referenced and Cloze-Type Testing: The DRP

Many of these problems can be alleviated through the use of a criterion-referenced, cloze-type test of reading comprehension. The use of a criterion reference overcomes some of the previously mentioned misinterpretations and biasing effects associated with grade-equivalent, normative scoring. A cloze procedure (or modification), involving elimination of individual words to be filled in by the student, may increase the probability that errors reflect misunderstanding of the surrounding text in the reading passage itself, rather than misunderstanding of a question or response option.

Such a test of reading comprehension is available in the Degrees of Reading Power (DRP) Test, published by the College Entrance Examination Board (1980). The DRP is designed to measure students' ability to understand English prose written at different levels of difficulty (or "readability"). The test consists of nonfiction passages, each about 325 words in length, arranged in order of increasing difficulty as determined by Bormuth's (1969) mean cloze readability formula.* A modified cloze procedure is used in which each passage includes seven sentences with one word deleted. For each blank,

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*The Bormuth formula provides an index of readability based on average word length, average sentence length, and the proportion of frequently-occurring words (derived from the Dale Long List).

five single-word response options are provided. All response options are high-frequency, relatively comprehensible words, and if the sentences containing blanks are considered in isolation, the response options are all grammatically correct and semantically reasonable. However, when the meaning of the surrounding text is understood, only one item provides a plausible completion for each blank. Thus, the difficulty of a cloze item depends on the readability of surrounding text, and the student should be able to respond correctly to most items until text difficulty increases to a level where the student no longer understands the passage well enough to select the correct response option. In this way, the DRP provides an estimate of reading ability measured with reference to a criterion scale of prose difficulty - the most difficult text that an individual can read with a specified level of comprehension.

DRP Scale of Readability

The readability or prose difficulty scale is determined by the Bormuth (1969) mean cloze readability formula which, as previously noted, is based on average word and sentence length, and proportion of high-frequency words. Theoretically, the scale ranges from 0 to 100 units, but for practical purposes, the range extends from 30 DRP units for very simple English prose to 85 units for the most difficult text. To make this scale more meaningful, Figure 1 indicates the average DRP readability scores for various publications, ranging from children's magazines to professional journals.

Figure 1 here

DRP Reading Test Scores

The DRP test of reading ability provides a raw score which is simply the number of items correctly answered. This raw score is converted to empirically-based DRP readability levels (prose difficulty) which the individual should

be able to read with varying degrees of comprehension. Three major levels of comprehension are specified:

1) The "Independent Level" represents material consistent with the student's reading ability. Given a passage at this level of prose difficulty, the student should be able to correctly answer about 90% (p=.90) of the questions on a reading inventory for that passage.
2) The "Instructional Level" includes more difficult material which is somewhat beyond the individual's reading ability, but is comprehensible with the help of a teacher or other instructional support. A student should be able to read a passage at this level and respond correctly to about 75% (p=.75) of the questions in a reading inventory.
3) The "Frustration Level" represents material which is so difficult for the reader that it can not be used effectively for instructional purposes. Materials at this level produce about 50% (p=.50) correct responses to questions about the passage.

For example, if a student has a DRP test raw score of 65, the Independent Level (p=.90) corresponds to prose difficulty with a DRP value of 62; the Instructional Level (p=.75) consists of more difficult material with a DRP value of 73; and the Frustration Level (p=.50) includes text with a DRP readability of 85.

Since the reading test score is directly interpreted in terms of level of prose difficulty which should be comprehensible at a given level, a major use of the DRP is in identifying reading materials which are appropriate in difficulty for individual readers. Of course, the test is also used to provide an estimate of student achievement in reading and a measure of growth in reading ability over time. The test is published in a number of forms, each of which covers a broad range of reading ability. A short pre-test is also

provided to identify the most appropriate form for the individual student. Actually, since all forms of the test are arranged on the same scale, any DRP form can be given if there are enough difficult passages to measure ability of the student with advanced reading skills, or enough simple passages to measure ability of the student with a lower level of reading achievement.

Purpose of This Study

The present study will investigate the applicability and research potential of the DRP Test for a sample of deaf college students. The distribution of reading comprehension scores on the DRP scale of prose difficulty will be examined and compared with the readability of textbooks at various grade levels, including college, to determine the degree of compatibility between text difficulty and student reading level. Comparisons will also be made with DRP test score distributions for hearing students at different grade levels. Finally, DRP reading scores will be correlated with factors such as degree of hearing loss, age at onset of deafness, articulation ability, and years of experience in sign communication. Previous research has suggested that such factors are often related to performance on traditional tests of reading ability (e.g., Brasel & Quigley, 1977; Conrad, 1971; Jensema, 1975).

METHOD

Subjects

The sample consisted of 100 hearing impaired Gallaudet College students (24 males and 76 females), distributed across the freshman to senior years, and ranging in age from 18 to 30. These subjects covered a wide range of audiological and experiential characteristics. For example, hearing loss extended from 27 dB to 120 dB (ANSI, better ear average), with a mean of 93dB. As with the Gallaudet population in general, however, the large majority of subjects were profoundly and prelingually deaf. Students were recruited from two large sections of General (Introductory) Psychology and several upper-level psychology courses. As an incentive, students received points added to their course grade for participation. Since the sample was not selected at random from the Gallaudet population, it is not strictly representative, and includes a disproportionately large number of females. However, the sample covers a wide spectrum of reading test scores and should provide a reasonable cross-section of reading abilities at Gallaudet.

Materials

Form "PA-4" of the DRP Test, which consists of 77 cloze-type items and 11 prose passages, was selected for use with students in the sample. This form spans an intermediate level of difficulty, and includes passages at both the easy and difficult ends of the readability scale. Students also filled out a brief questionnaire providing such information as age, hearing loss, age at onset of deafness, and years of sign experience.

Procedure

The DRP Test was administered to student volunteers in small groups. An attempt was made to motivate students to do their best by use of an incentive system which provided an increasing number of course grade points for the

individual with increasing scores achieved on the reading test. Raw scores (number of items correct) were converted to DRP readability scores at the "Instructional Level" (p=.75) of difficulty to plot a frequency distribution. Background information provided by students on the questionnaire was checked for accuracy with student records prior to correlational analysis.

RESULTS

DRP scores at the "Instructional Level" of difficulty (75% comprehension) were plotted in a grouped frequency distribution, shown in Figure 2. The mean of this distribution is 69 (median=65.5), with a standard deviation of 12.7. The distribution is essentially bimodal, with one peak in the range 55-64, and another peak in the interval 75-79. To help make this distribution more meaningful, the readability values for various kinds and levels of reading material are also indicated on the graph.

Figure 2 here

Although the DRP is not a norm-referenced test, norms for hearing students at different grade levels are provided by the College Board (1983,b). For comparison, the distributions of DRP scores at the Instructional Level for hearing students are shown for grades 4-12 in Figure 3.

Figure 3 here

Since the distribution of DRP reading scores in Figure 2 is bimodal, a comparison was made between prelingually deaf (deaf before age three) and postlingually deaf subjects. The majority of students in the sample (and at Gallaudet generally) are in the prelingually deaf category (N=85). The distributions for these two groups, showing the percent of subjects in each

DRP score interval, are presented in Figure 4. Again, for reference purposes, the readability values for various kinds of reading materials are indicated.

Figure 4 here

The two distributions show considerable overlap, and both have bimodal (or even multi-modal) characteristics. The prelingual group shows a low peak in the DRP range 55-64 and a high peak in the interval 75-79, with a mean of 67 (median=64) and a standard deviation of 11.2. The postlingual group shows a shift upward, with a low peak in the range 65-84 and a high peak above 90, with a mean of 82 (median=81) and a standard deviation of 13.4. The difference between the prelingual and postlingual means is statistically significant ($p < .01$), as determined by a t-test for independent groups. However, the small number of subjects in the postlingual category (N=15) must be considered in interpreting results for this group.

The College Board annually publishes a Readability Report (1983,a) which provides the DRP difficulty levels of published instructional materials and textbooks at various grade levels. It is interesting to compare these readability scores with average DRP reading performance scores at the Instructional Level (75% comprehension) across school grades. This comparison is shown in Figure 5, which includes the mean score from the sample of deaf subjects in this study. This graph reveals that below the seventh grade, the readability of texts is above the average reading ability of students , while above the seventh grade level, this relationship is reversed.

Figure 5 here

The DRP is constructed of passages which increase in difficulty from the beginning of the test to the end. The validity of the test for deaf students is dependent, in part, on the extent to which the test passages

provide such a progression in difficulty for students in this sample. Therefore, the number of incorrect responses for each of the 77 items in the test was determined, and the average number of errors per item was calculated for each passage. Figure 6 provides this error distribution across the eleven passages in the test, and reveals a general trend toward progression in test difficulty in spite of some fluctuation in error rate between passages.

Figure 6 here

Finally, reading test scores from the hearing impaired sample were correlated with a number of other variables. To begin with, Gallaudet students generally take a battery of tests in applying for admission, including the Cooperative English Tests in Reading Comprehension (Educational Testing Service, 1960), and a special Gallaudet Reading Proficiency Test. Scores on these tests were available for about 55% of the students in the sample, and Pearson r correlations were calculated with DRP scores. Rather strong, positive correlations emerged, with $r=+.69$ between DRP scores and Cooperative Test scores, and $r=+.62$ between the DRP and the Gallaudet Reading Test.

Correlations between DRP reading scores and various audiological and experiential factors are presented in Table 1. Hearing loss data were derived from standard audiological evaluations (ANSI, 1970). Years of signing experience were obtained from students' responses to the background questionnaire. Ratings of articulation ability and speechreading ability (with sound) were obtained from evaluations by trained panels of judges (Garretson & Jordan, 1982).

Table 1 here

For the entire sample, there is a negative correlation ($r=-.18$), which is not significant, with the degree of hearing loss (better ear average). This negative correlation increases to a significant r of $-.26$ ($p < .05$) for the prelingually deaf subjects. For the postlingually deaf group, the correlation is positive ($r=+.21$), although not significant.

The strongest correlation ($r=+.54$) is with rated articulation ability, and is highly significant ($p < .01$). Speechreading ability shows a small (not significant) positive correlation ($r=+.19$) with DRP scores. The correlation with years of signing experience is negative, but very small ($r=-.10$) and not significant.

DISCUSSION

The bimodal distribution of reading test scores evident in Figure 2 is consistent with the diversity which is often observed in educational programs for hearing impaired students. At first, it seems reasonable to attribute this bimodal arrangement largely to prelingual vs. postlingual deafness. However, when these groups are plotted separately in Figure 4, each group shows its own bimodal distribution, with the entire postlingual group shifted toward somewhat higher scores. Most of the lower-scoring students in the postlingual group are reading at a higher level than the low-scoring students in the prelingual group. The high-scoring students in the postlingual group are reading within the highest ranges of proficiency tested by Form "PA-4" of the DRP. This result reflects the importance of early language acquisition in the development of reading ability. However, further examination of the data revealed that within each group the distribution of reading scores is not well accounted for by the age at which deafness occurred.

The DRP distributions for hearing students at different academic grade levels, shown in Figure 3, are approximately normal and do not display any

bimodal trends. The mean for the deaf sample (69) falls between the means of the 9th and 10th grade distributions for hearing norms. The mean of 69 is almost the same as the average readability or difficulty of introductory level college texts (DRP=70). The implication is that students with this DRP score should be able to read the average introductory college text with about 75% comprehension. However, validation of the DRP test with deaf students is needed for proper interpretation of scores. For hearing students, the conversion from raw score to DRP level of prose difficulty is empirically determined. For deaf students, however, the conversion from raw test score to level of difficulty which can be comprehended may be somewhat different than for hearing students.

Relevant to this point are the results in Figure 6, showing mean response errors across the eleven reading passages. The test is constructed of passages which progressively increase in difficulty, as determined by the Bormuth readability formula and by studies with hearing subjects. Therefore, the validity of the test for deaf subjects is partly dependent on how well the distribution of responses from deaf subjects fits the progression of difficulty provided by the reading passages. Figure 6 reveals a general trend toward increasing errors across the reading passages, but with some fluctuation, particularly for the last passage which produced a lower error rate than expected. Therefore, the conversion from test score to comprehension level derived for hearing students may need some revision for use with deaf students. Further research is necessary using larger samples of hearing impaired students to determine the degree of comprehension for passages at different levels of difficulty.

The relationship between comprehension and textbook difficulty across academic grades is shown in Figure 5. The data seem to show that, on the average, from grades four to seven reading materials are too difficult, and

should produce less than 75% comprehension. For grade eight and beyond, the relationship is reversed with reading ability above the level of text difficulty. However, this reversal effect may be somewhat exaggerated due to the failure of the readability formula sufficiently to take into consideration the degree of abstraction in reading materials. In the elementary grades, materials are concrete in reference, and therefore easy to understand even if the indices measured by the readability formula (word length, sentence length, proportion of frequent words) are at a relatively higher level of prose difficulty. At the upper grade levels, educational materials are semantically more abstract, requiring more advanced logical operations for comprehension, even though the readability indices are at a relatively less difficult level. This question may be worth further investigation.

Some of the factors involved in reading comprehension as measured by the DRP may be suggested by the correlations in Table 1. Previous research has shown that reading achievement is inversely related to hearing loss (Trybus & Karchmer, 1977; Trybus, 1978; Jensema, 1975). At first glance, the small size of the negative correlation for the entire subject sample between DRP reading level and degree of hearing loss is surprising. It would be expected that a small dB hearing loss, which allows some auditory speech discrimination, would be associated with higher levels of reading ability, while a larger hearing loss would be associated with poorer reading performance, yielding a strong negative correlation. However, for those who become deaf after three years of age, the degree of hearing loss has less impact on reading development since some understanding of spoken language has already

been acquired at the time of deafness. Furthermore, postlingual deafness is often a progressive hearing loss which allows language learning and reading development to continue for some time before the hearing impairment becomes severe. Thus, when the postlingually deaf group is separated from the sample, the remaining prelingually deaf students show a stronger (and significant) negative correlation ($r=-.26$) between reading performance and degree of hearing loss. The fact that this correlation is still rather modest may be attributed to the large proportion of severe to profound hearing loss within the group, which depresses the size of the correlation coefficient.

The relatively strong correlation ($r=+.54$) between reading performance and ratings of subjects' speech articulation reflects the importance of knowledge of speech in the development of reading ability. Written language is essentially a coded representation of the spoken language, and learning to read is greatly facilitated by a knowledge of the phonetic and grammatical structure of speech. The interaction between speech articulation and reading performance has been investigated by Conrad (1970; 1971), among others.

By comparison, ratings of speechreading ability (with voice sound included) produced a smaller, non-significant correlation ($r=+.19$) with reading test performance. Speechreading ability is a skill which is difficult to acquire and is less directly related to knowledge of spoken language than articulation ability. Hence, it is less important as a variable influencing reading comprehension.

A number of previous studies have shown that reading test performance in deaf children is enhanced by the early use of manual communication (Brasel & Quigley, 1977; Meadow, 1968; Vernon & Koh, 1970). This study used years of experience in sign communication as a simple measure of sign language fluency and usage. However, the correlation with DRP reading

performance was very small ($r=+.10$). The failure of this finding to confirm results of previous research may reflect an inadequacy of the measure of sign communication or may suggest that in fact there is little relationship between manual communication usage and reading performance for subjects in this sample. Further work is needed to resolve this issue.

This study provides a basis for further use of the DRP Test in research and educational assessment with deaf students. Further research is needed to establish the relationship between prose difficulty and level of comprehension on the DRP scale for deaf subjects. Research might also be done with a modification of the DRP passages involving an open-ended cloze procedure, in which subjects generate their own response for each deleted word, instead of selecting from multiple-choice options. Item analysis of subject responses would reveal how semantic and grammatical errors are related to passage difficulty. Such studies would add to our knowledge of the validity of the DRP Test and, more generally, cloze procedures for assessment of psycholinguistic ability with deaf subjects, following the research of LaSasso (1980), Moores (1970), Odom, Blanton & Nunnally (1967), and others.

The DRP Test also offers a valuable new tool for the assessment of reading achievement in deaf students. The modified cloze procedure (with multiple-choice options) provides a simple and direct measure of prose comprehension which overcomes some of the interpretational problems inherent in tradiational reading tests using comprehension questions. Measuring reading performance on a scale of prose difficulty which can be understood, at some specified level, enables educators to identify reading materials which are appropriate in difficulty for an individual or group. The use of this criterion reference also avoids some of the problems of interpretation and bias which can occur for norm-referenced tests.

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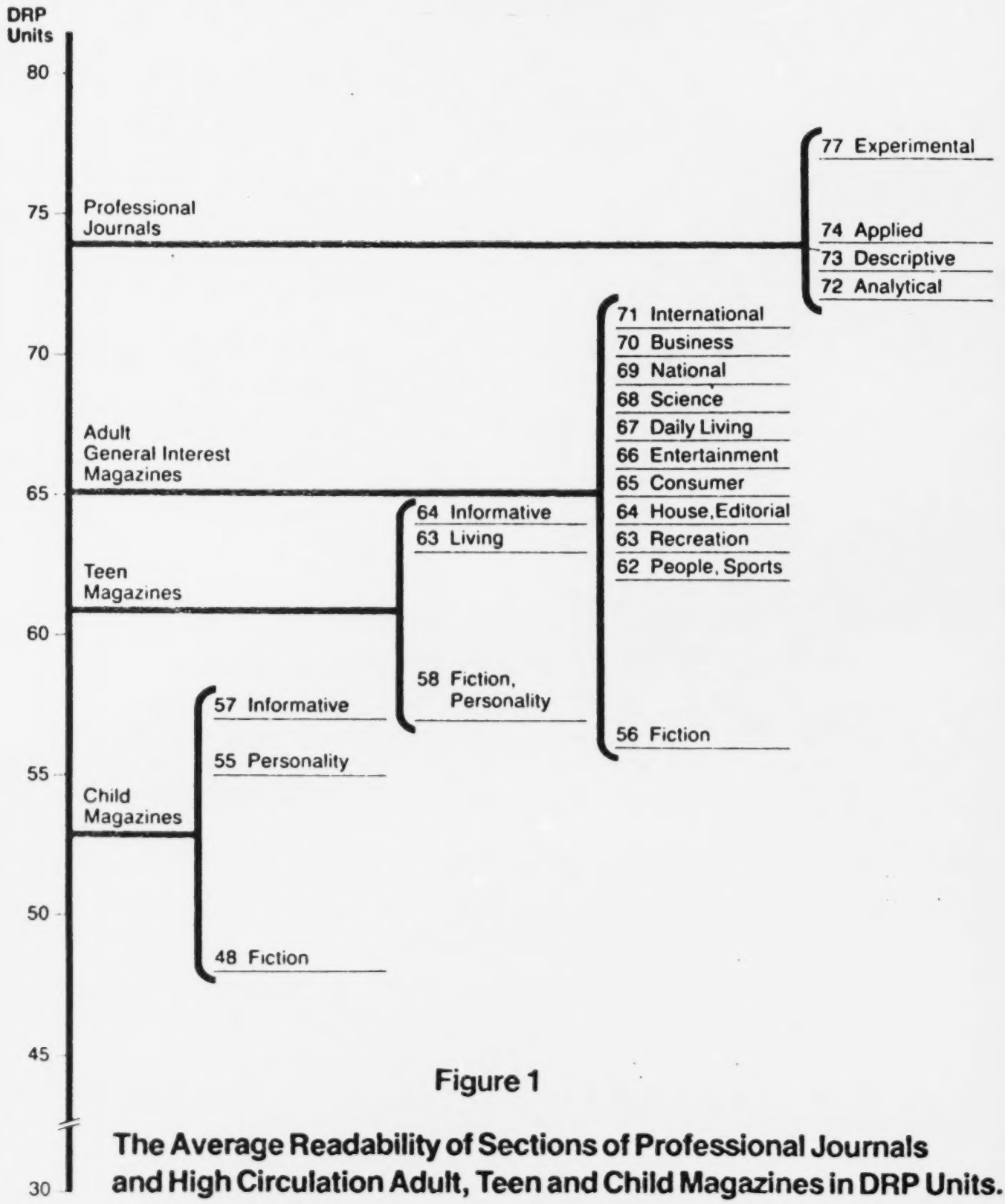

Figure 1

The Average Readability of Sections of Professional Journals and High Circulation Adult, Teen and Child Magazines in DRP Units.

(College Entrance Examination Board, 1983,a)

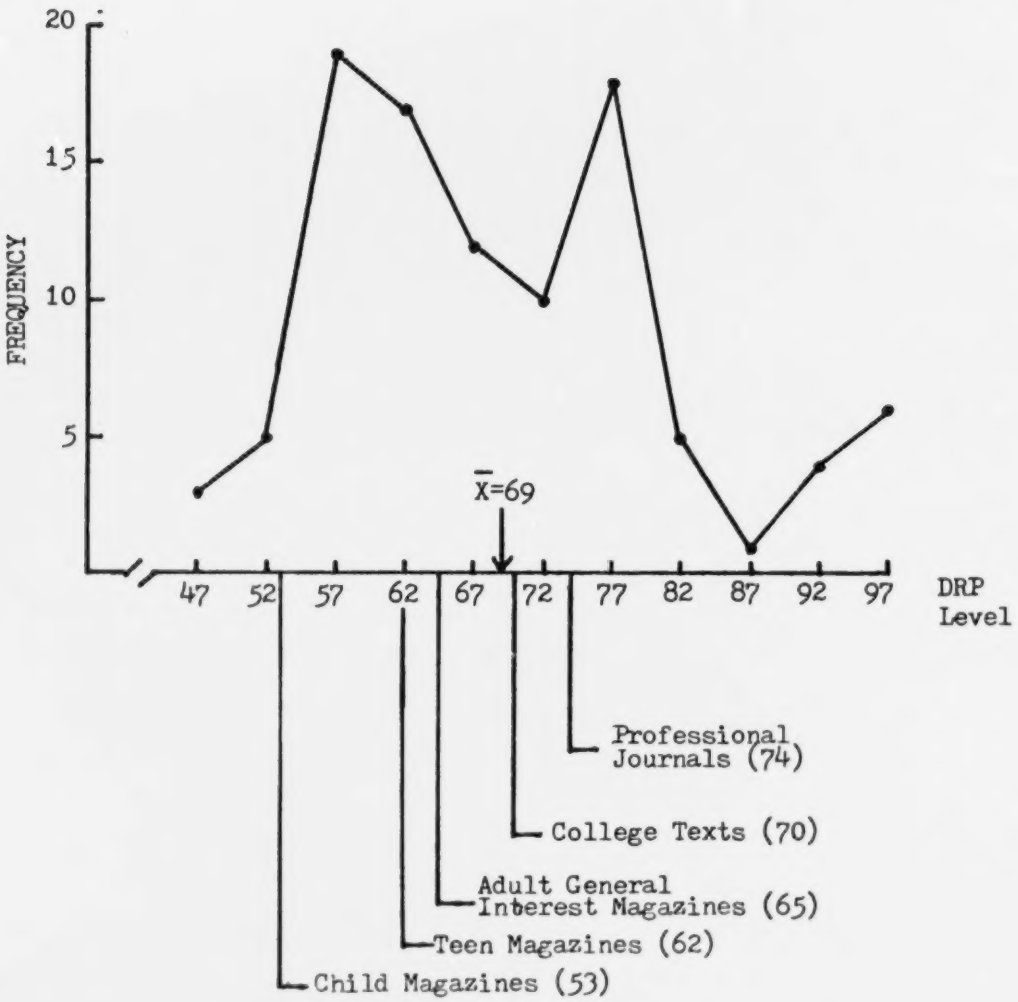

FIGURE 2

Frequency Distribution of DRP Scores (Instructional Level: p=.75) for Hearing Impaired College Students in Relation to Text Readability (Grouped Data)

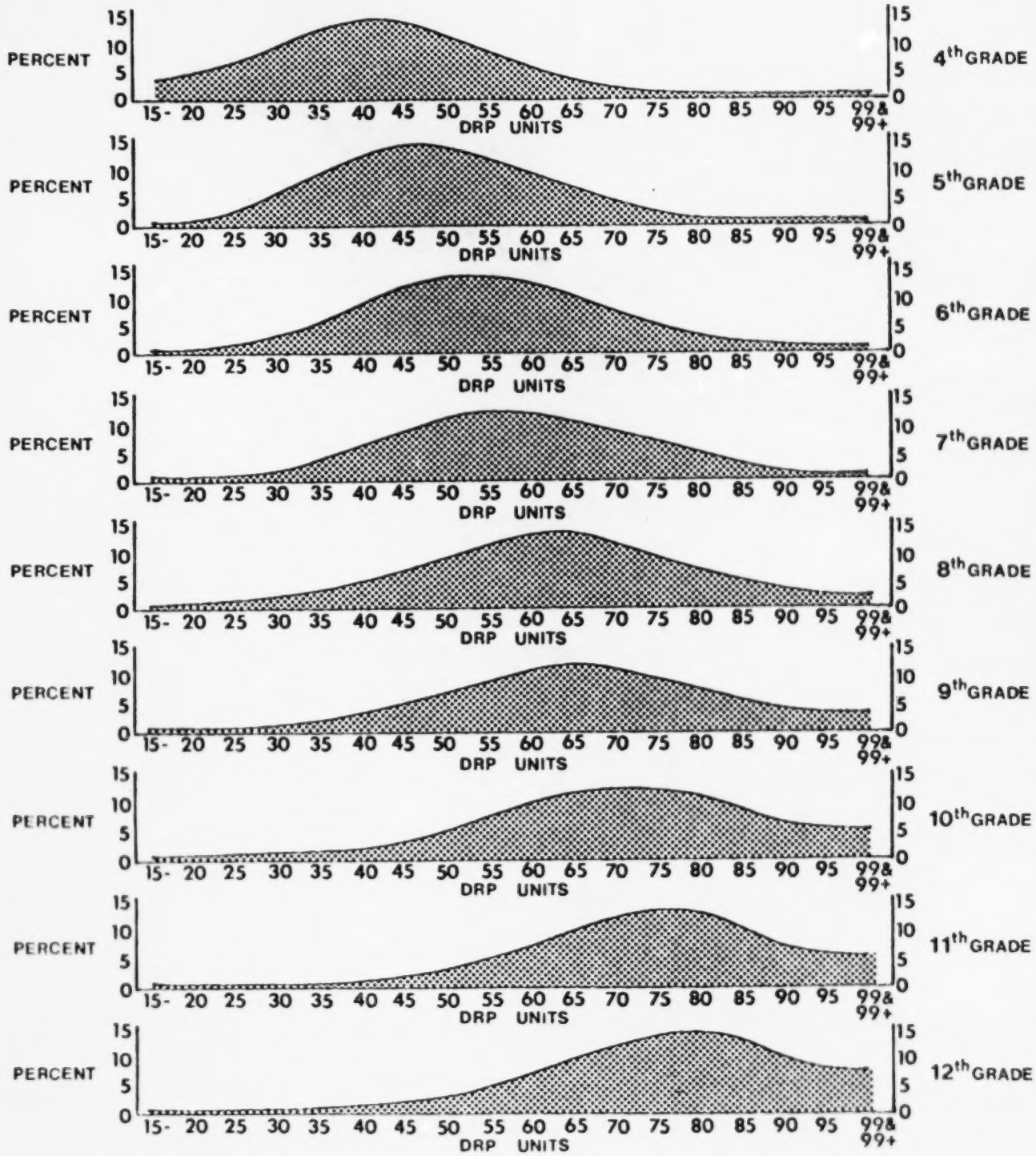

FIGURE 3

PERCENT OF STUDENTS AT MID-INSTRUCTIONAL LEVEL (P=.75) IN DRP UNITS BY GRADES IN THE SPRING

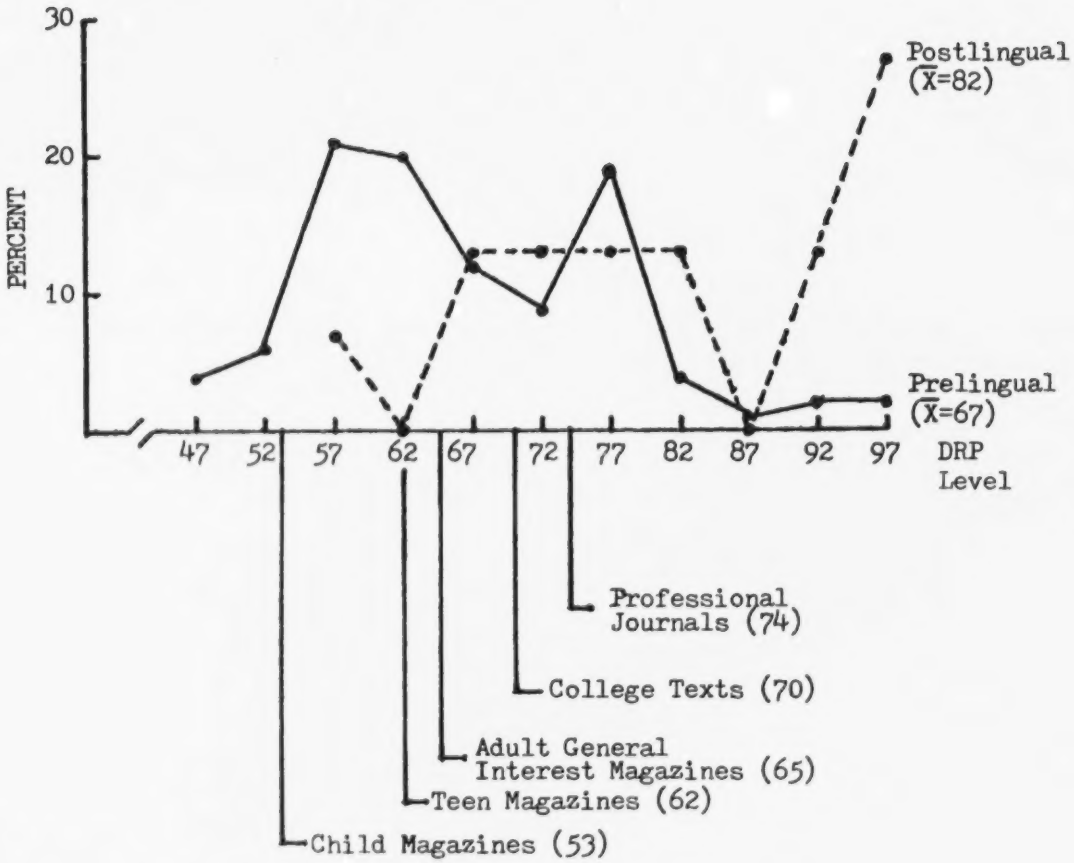

FIGURE 4

Grouped Distribution of DRP Scores (Instructional Level) for Prelingual (N=85) and Postlingual (N=15) Deaf College Students in Relation to Text Readability

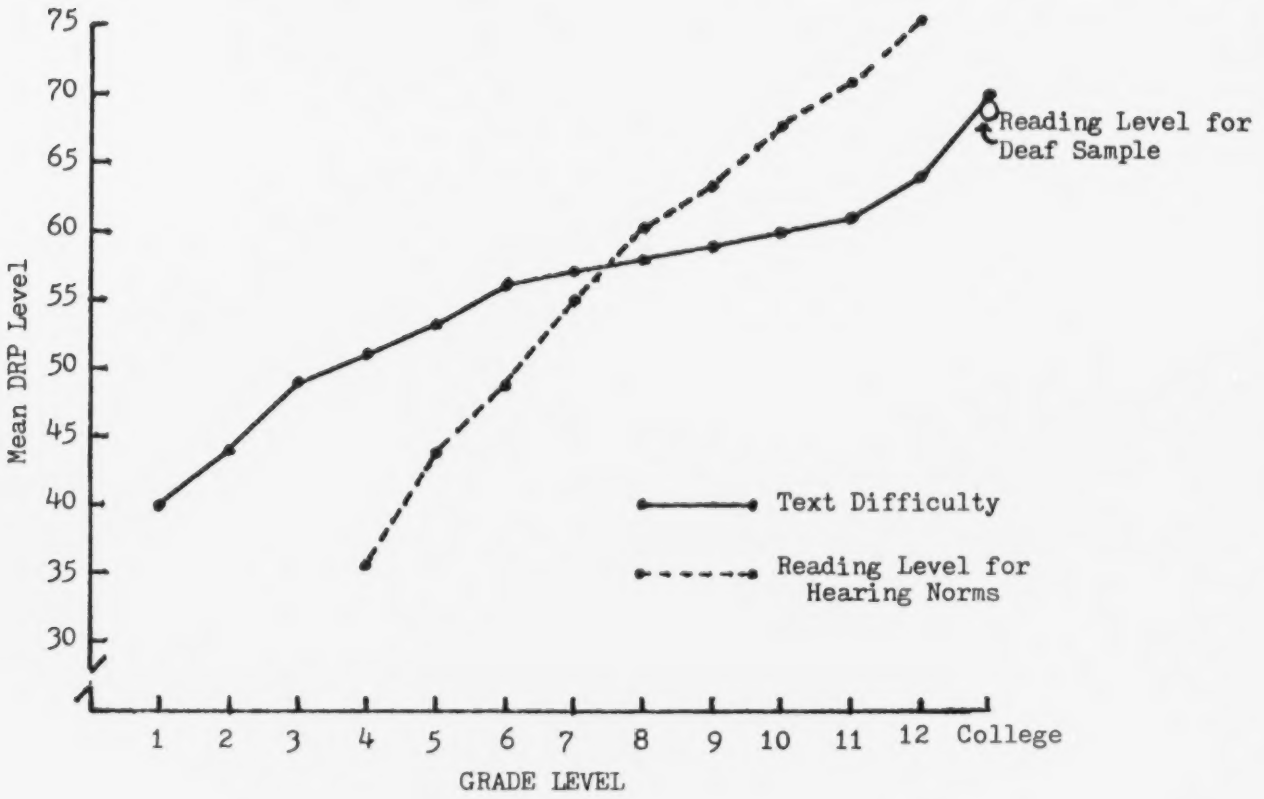

FIGURE 5

Mean Textbook Readability vs. Mean DRP
Reading Scores (Instructional Level) by Grade

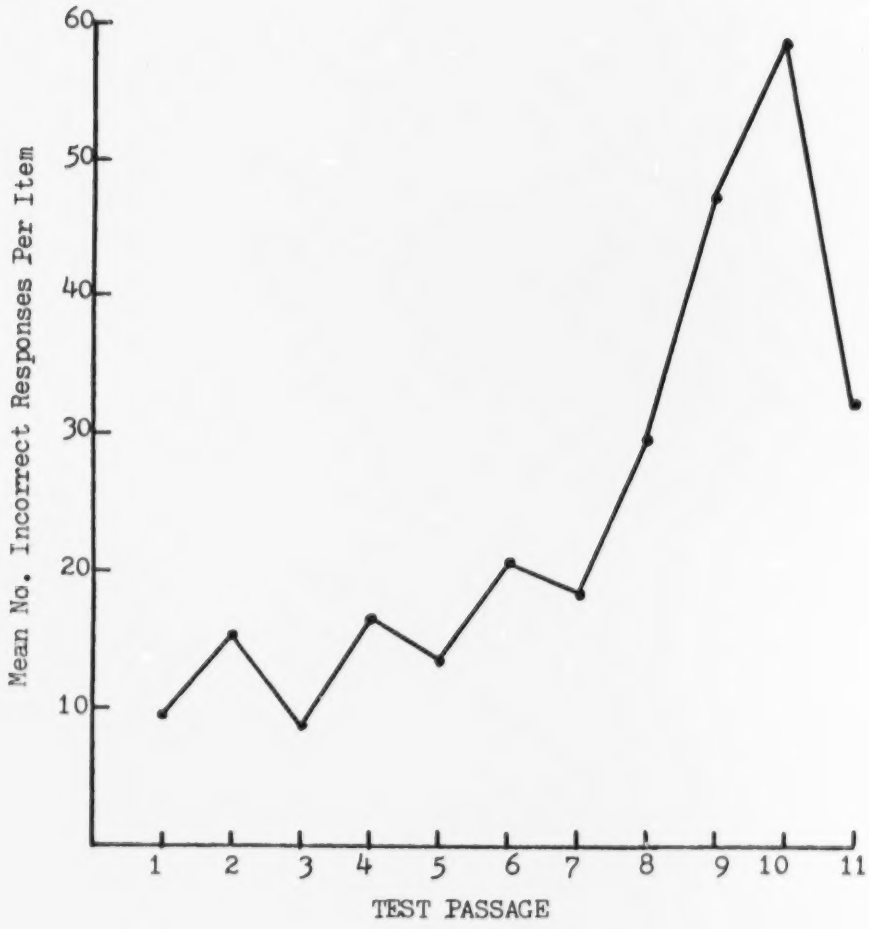

FIGURE 6

Mean Number of Incorrect Responses Per Item
for DRP Test Passages

TABLE 1

Correlations Between DRP Test Scores and Other Variables

DRP vs.:	Degree of Hearing Loss (Better Ear Average)			Ratings@ of Articulation	Ratings@ of Speechreading	Years of Sign Communication
	Entire Sample	Prelingually Deaf	Postlingually Deaf			
r	-.18	-.26*	+.21	+.54**	+.19	-.10
(N)	(91)	(79)	(12)	(81)	(81)	(97)

*Significant ($p < .05$)

**Significant ($p < .01$)

@Spearman Rank Order Correlation